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Practice on the Integration of Intelligent Manufacturing Professional Education and Innovation and Entrepreneurship

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Abstract: *The cultivation of professionals in intelligent manufacturing is of great significance for the development of the industry. Currently, there are problems in this major, such as the lack of innovation and entrepreneurship awareness in talent cultivation, the lagging behind of talent cultivation in relation to industrial development, and the lack of diversification in the cultivation model. Therefore, paths for the integration of professional education and innovation and entrepreneurship are proposed, covering cooperation with the innovation and entrepreneurship college, focusing on the local economy, deepening school-enterprise cooperation, and optimizing teaching content. This is of great significance for solving the dilemma of talent cultivation and promoting the innovation of professional education.*

Keywords: *Intelligent Manufacturing; Innovation and Entrepreneurship; Curriculum System*

1. Introduction

With the rapid development of global industrialization, intelligent manufacturing, as the core of a new round of industrial revolution, has become an important engine for promoting national economic development and industrial upgrading. As the world's largest manufacturing country, China is actively promoting the development of intelligent manufacturing to enhance the competitiveness of the manufacturing industry and achieve high-quality economic development. Intelligent manufacturing is an important driving force for promoting high-quality national economic development in the new era. Multiple departments, including the National Development and Reform Commission, the Ministry of Education, and the Ministry of Science and Technology, jointly issued the "Opinions on Accelerating the High-quality Development of the Manufacturing Service Industry", providing a clear development path for the development of high-end equipment manufacturing, intelligent manufacturing, and artificial intelligence, and promoting the strategic emerging industries of intelligent manufacturing to enter a period of rapid growth [1-3]. Shanxi Province has proposed major policies to vigorously develop characteristic new equipment during the "14th Five-Year Plan" period, and has carried out an overall layout of the province's high-end equipment and intelligent manufacturing industries, focusing on carrying out relevant intelligent manufacturing industry layouts in the fields of advanced rail transit, coal mining machinery, and medical health. In order to meet the new expectations and requirements of the development of the national high-end equipment manufacturing industry for the talent needs of colleges and universities, in 2021, Jinzhong College of Information was approved for the major direction of intelligent manufacturing engineering. Therefore, professional education in the field of intelligent manufacturing engineering has important significance and practical value [4-5].

The transformation and development of Shanxi Province's manufacturing industry requires the cultivation of high-quality intelligent manufacturing professionals as soon as possible. At present, the talent cultivation mode, discipline construction, and practical teaching platform construction of intelligent manufacturing engineering majors in our province, including Jinzhong Information College, are relatively weak. Especially in the intelligent manufacturing industry, which is a knowledge intensive industry with interdisciplinary convergence and intersection, it is necessary to cultivate innovative composite new engineering talents who not only understand mechanical manufacturing, electrical control, sensing and detection, but also algorithms and programming. Faced with the rapid development of high-end equipment industries such as coal mines and big health, our province's enterprises lack sufficient talent reserves in the research and development of equipment intelligence and intelligent manufacturing. Many technical personnel only stay at the level of using intelligent manufacturing, resulting in a clear disconnect between talent cultivation and enterprise and market

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demand. Reforming the traditional talent training model, breaking down traditional professional barriers, exploring interest driven intelligent manufacturing innovation and entrepreneurship talent training models, in order to expand the scale of talent training, solve the bottleneck of talent shortage, weak personalization, and weak innovation and entrepreneurship awareness in industry development, is an important issue that our province's universities urgently need to address in the intelligent manufacturing professional technical talent training system.

Intelligent manufacturing, as one of the important fields of new engineering, has become an important direction for the reform of higher education and teaching. Intelligent manufacturing also plays an important role in promoting innovation and entrepreneurship. The development of intelligent manufacturing technology provides vast space and opportunities for innovation and entrepreneurship, while also placing higher demands on innovative and entrepreneurial talents. By strengthening the integration of innovation and entrepreneurship education with professional education, more talents with innovative spirit and entrepreneurial ability can be cultivated, providing strong talent guarantee for innovation and entrepreneurship in the field of intelligent manufacturing. Deeply integrating innovation and entrepreneurship education with professional education can help cultivate students' innovative spirit and practical ability, enhance their comprehensive quality and employment competitiveness. Therefore, studying the deep integration path of innovation and entrepreneurship with professional education for intelligent manufacturing engineering has important guiding significance for promoting the construction of new engineering disciplines and educational reform[6-7].

2. The main problems in the cultivation of intelligent manufacturing professionals

(1) Lack of innovation and entrepreneurship awareness in talent cultivation in the field of intelligent manufacturing

Intelligent manufacturing is a technology closely related to applications, which concerns all aspects of social production and people's lives. Therefore, the innovative development of intelligent manufacturing products and technologies requires a systematic understanding of the core technology, industrial chain, application background, application status, and scale of intelligent manufacturing. However, the training of talents in the intelligent manufacturing professional module focuses more on the explanation and teaching of basic theories and technologies in intelligent manufacturing, neglecting the cultivation of students' innovation consciousness and entrepreneurial spirit, critical thinking, insight, decision-making ability, organizational coordination ability, leadership and other innovative and entrepreneurial qualities. It does not guide students to form a correct understanding of the enterprise and industry environment, entrepreneurial opportunities and risks, business models and business strategies and skills. Therefore, how to seek reasonable entry points on the basis of existing training models, take effective measures to stimulate students' enthusiasm for innovation and entrepreneurship, and their creativity in practical exploration, is a new breakthrough point for the cultivation of composite and high-quality talents in the field of intelligent manufacturing.

(2) The cultivation of intelligent manufacturing talents lags behind industrial development

From the perspective of professional training, whether it is new or traditional majors, the scale of talent cultivation will be constrained by the enrollment scale. The four-year university system makes the enrollment scale of the current year's major affect the talent base that will enter the industry four years later. The Intelligent Manufacturing Engineering major is a new type of major that started enrolling students for the first time in China in 2018 and has a small scale. Compared with the talent demand of the rapidly developing intelligent manufacturing industry, talent cultivation lags behind the industry's development needs. From the perspective of the timing of the establishment of intelligent manufacturing majors, the number of graduates in the existing intelligent manufacturing majors is relatively small, and the competition for intelligent manufacturing talents between regions is fierce. The central and western regions are at a disadvantage, which to some extent affects the high-quality promotion of the national strategy. Therefore, how to innovate the existing specialized talent training model and expand the scale of student training with intelligent manufacturing knowledge system is one of the problems faced by talent training in the field of intelligent manufacturing.

(3) Lack of diversification in talent cultivation in the field of intelligent manufacturing

The intelligent manufacturing major is a typical interdisciplinary field with high knowledge intensity. In the process of research and development, design, and application, specialized talents who understand both personalized production processes in various industries and intelligent manufacturing

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technology are needed. However, it is not convenient for so many industrial production fields to be fully covered in the training syllabus and course catalog of intelligent manufacturing engineering majors, which also leads to a lack of practical talents who are "readily available and capable of fighting" in enterprises. Therefore, how to build a new talent cultivation model with diverse professional backgrounds and complementary curriculum systems outside the talent cultivation system of intelligent manufacturing professional modules, in order to solve the problem of the disconnect between talent cultivation in the direction of intelligent manufacturing and industrial production reality, is another problem faced by talent cultivation in the direction of intelligent manufacturing.

In summary, the direction of intelligent manufacturing requires a new talent cultivation model that focuses on professional modular talent cultivation, supplemented by innovation, entrepreneurship, and interest practice cultivation. This model aims to improve students' hands-on ability, practical innovation, and independent entrepreneurship ability. Based on the specialized curriculum system, it seeks the integration points between different disciplinary backgrounds, application fields, and intelligent manufacturing technologies, and constructs an innovative practical talent cultivation model of "intelligent manufacturing+" to promote the high-quality and rapid development of the intelligent manufacturing industry.

3. The path of integrating professional education with innovation and entrepreneurship

The integration of professional education and innovation and entrepreneurship requires a focus on local economic and industrial needs, as well as expanding students' innovative perspectives; Using competitions as a medium to promote the deep integration of innovation and entrepreneurship with professional education; Deepen school enterprise cooperation and build a co built platform for entrepreneurship and education between schools and enterprises; Joint Entrepreneurship and Innovation College, forming a collaborative effort to cultivate entrepreneurial and innovative talents. Through this series of research and practice, we aim to cultivate more high-quality talents with innovative spirit and practical ability in the field of intelligent manufacturing for applied undergraduate colleges, and promote the sustained innovation and development of the intelligent manufacturing industry.

(1) Joint Innovation and Entrepreneurship Academy, jointly cultivating innovation and entrepreneurship talents

In the process of promoting the integration of intelligent manufacturing education and innovation and entrepreneurship, working together with the School of Innovation and Entrepreneurship has become a key move to jointly cultivate innovation and entrepreneurship talents. The School of Entrepreneurship and Innovation carefully selects and dispatches a team of highly professional entrepreneurial mentors to engage in in-depth cooperation with teachers who are deeply involved in the field of intelligent manufacturing. Both parties work closely together to carefully design an innovation and entrepreneurship curriculum system and practical projects that meet the needs of the times. During this process, entrepreneurial mentors rely on their rich market experience and keen industry insights to ensure that the course content accurately aligns with actual entrepreneurial needs, making everything students learn applicable; And teachers in the field of intelligent manufacturing provide strong support from the level of professional technical knowledge, ensuring that the curriculum has a profound professional background. In this way, not only can the course content closely fit the actual entrepreneurial needs, but it can also provide students with practical opportunities to highly reproduce real entrepreneurial scenarios.

The School of Entrepreneurship and Innovation fully leverages its extensive and powerful alumni network as well as rich and diverse entrepreneurial resources to actively build a broad entrepreneurial platform for students majoring in intelligent manufacturing. On the one hand, by regularly organizing exciting entrepreneurship lectures and inviting successful individuals in the field of entrepreneurship to come and share their ups and downs in their entrepreneurial journey and valuable experience; On the other hand, various forms of entrepreneurship salon activities are held to create a relaxed and active communication atmosphere, allowing students to freely express their entrepreneurial ideas and confusion. In these activities, students are able to come into contact with numerous vivid and lively entrepreneurial success cases as well as highly practical practical experience, which greatly stimulates their deep entrepreneurial enthusiasm and enhances their confidence in joining the entrepreneurial wave.

(2) Focusing on the local economy and expanding innovative perspectives

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It plays an important role in the integration of intelligent manufacturing education and innovation and entrepreneurship practice that cannot be ignored. The school actively organizes students to study academic reports carefully prepared by experts both inside and outside the school. On campus experts, with their rich experience in teaching and research, combined with the development practice of intelligent manufacturing in our school, explain professional knowledge and technological applications in a simple and understandable manner. External experts mostly come from cutting-edge enterprises or well-known research institutions in the industry, bringing the latest developments and trends in the global intelligent manufacturing field. Through these academic reports, students are guided to gain a deeper understanding of the country's strategic layout in the field of intelligent manufacturing, such as the key support and planning for high-end equipment manufacturing and intelligent manufacturing in "Made in China 2025". At the same time, students are given a clear understanding of the region's development advantages in manufacturing infrastructure, industrial policies, talent reserves, and other aspects. In this process, we gradually help students establish cutting-edge thinking in technology, enabling them to have a keen insight into the future direction of the industry, accurately distinguish the connection between innovation and entrepreneurship and the forefront of technology, understand how to use emerging technologies to develop innovative business models, and how to rely on cutting-edge concepts to embark on a new journey of entrepreneurship.

To further broaden students' horizons, the school regularly organizes various forms of online and offline interactive exchange meetings between students and innovation and entrepreneurship students from universities such as Shanxi Agricultural University and Taiyuan University of Technology. In offline communication activities, themed seminars are held where students from various schools engage in lively discussions on the innovative applications of intelligent manufacturing in different fields such as agriculture and industry, sharing their experiences and lessons learned in project practice; Carry out innovation and entrepreneurship project roadshows, where students showcase their creative projects and receive feedback and suggestions from other university students and professional mentors. In terms of online communication, we will establish a dedicated communication platform and regularly hold online forums using video conferencing systems. Students can share their confusion and experiences in the process of innovation and entrepreneurship at any time, and students from other universities will respond and help in a timely manner. Through these exchange activities, students can not only share their experiences in innovation and entrepreneurship, learn from each other's strengths in project planning, technology application, team collaboration, and make up for their own shortcomings, but also exercise their communication skills through frequent communication and interaction. They can expand their thinking dimensions from the thinking patterns and innovative perspectives of students from different universities, break through their own thinking limitations, and inject new vitality into innovation and entrepreneurship.

(3) Deepen school enterprise cooperation and jointly build a platform for innovation and entrepreneurship

Actively establishing deep cooperative relationships with enterprises and jointly building a platform for innovation and entrepreneurship education is the key path to promoting the integration of intelligent manufacturing professional education and innovation and entrepreneurship practice. The school adheres to the concept of openness and win-win, takes the initiative to negotiate with many influential local enterprises in the field of intelligent manufacturing, from industry-leading large manufacturing enterprises to innovative small and medium-sized enterprises focusing on emerging technology research and development, all of which are included in the cooperation vision, striving to build a comprehensive and multi-level cooperation bridge.

In the process of school enterprise cooperation, schools make full use of the resource advantages of enterprises and actively introduce practical projects from enterprises. These projects cover various aspects of intelligent manufacturing, from the design and development of intelligent products, to the optimization of intelligent production processes, and to the operation and management of intelligent factories. Enterprises introduce real projects they are promoting onto campus, allowing students to participate as if they were in the actual work environment of the enterprise. For example, in a certain intelligent robot development project, students participate in robot appearance design, algorithm optimization, and functional testing with enterprise engineers, and learn how to apply their professional knowledge to actual product development through practice. At the same time, various resources of enterprises are also open to schools, such as advanced production equipment, professional experimental testing instruments, and rich industry databases, providing students with rich practical materials and advanced practical conditions. Through close cooperation between schools and enterprises, schools can more accurately grasp industry demands.

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(4) Optimize teaching content and cultivate innovative consciousness

In the practice of integrating intelligent manufacturing education with innovation and entrepreneurship, optimizing teaching content and cultivating students' innovative consciousness occupy a core position. The school starts from multiple dimensions and comprehensively reforms the teaching system.

Firstly, make in-depth adjustments to the training program and vigorously increase the proportion of practical activities. In the curriculum, a rich and diverse range of experimental courses are carefully planned, covering various key areas of intelligent manufacturing. For example, in the experiment of intelligent perception and control, students gain a deep understanding of the principles and practical applications of data acquisition, signal processing, and precision control by operating advanced sensor devices and intelligent control systems. The internship program closely collaborates with well-known companies in the industry, providing students with opportunities to delve into the production front lines of these companies. The students walked into the smart factory and personally participated in the daily operation, maintenance, and optimization of the intelligent production line, truly experiencing the application of technology and management processes in the actual production environment. In terms of course design, challenging comprehensive tasks are assigned, requiring students to design and implement a complete small-scale system based on intelligent manufacturing technology. At the same time, project-based learning is vigorously promoted, and teachers divide students into project groups around practical intelligent manufacturing projects, such as the optimization and upgrading of intelligent logistics and warehousing systems. They participate in project operations like enterprise project teams, from requirement analysis, solution design, implementation to final delivery, and exercise their ability to solve practical problems in practice.

At the same time, a comprehensive review and adjustment of the curriculum outline will be conducted, and practical oriented curriculum design will be carried out. Finally, we attach great importance to the integration of subject competitions and innovation and entrepreneurship competitions. The school has established a competition project management team, which includes experienced professional teachers, senior engineers from enterprises, and competition organization experts. They jointly developed a detailed competition project participation process and a comprehensive guidance plan. There are clear plans and guidance for the selection of competition projects, student registration and team building, pre competition training, project implementation, and post competition summary. At the same time, a fully functional competition communication platform will be established, where students can share their competition experience, exchange technical difficulties, and seek opportunities for cooperation.

4. Conclusion

In response to the existing problems in talent cultivation in the field of intelligent manufacturing, implementing a path of integrating professional education and innovation and entrepreneurship, such as the Joint Innovation and Entrepreneurship College, can stimulate students' awareness of innovation and entrepreneurship, promote the synchronization of talent cultivation and industrial development, and build a diversified training model. This is not only beneficial for cultivating innovative talents that meet the needs of the industry, but also injects vitality into the intelligent manufacturing industry, helps the industry to sustain and develop healthily, and enhances overall competitiveness.

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